Enteric protection after antibiotics

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In feed antibiotics in the European Union are now just a memory after their ban at the beginning of this year. Over their lifespan, they became nothing less than the cornerstone strategy to reduce enteric disequilibrium and disease, and improve animal performance especially in young livestock.

Since then, considerable time, effort and expense have been invested in the development and evaluation of alternative products, including acidifiers, enzymes, prebiotics, probiotics and plant extracts leading to the universal conclusion that an effective strategy lies not on one, but most often a combination of products.

However, clear synergies still remain to be shown in several situations such as post-weaning. With this in mind, research is actively ongoing on 'product partnering' solutions which improve animal performance, while reducing feeding costs over the weaning period.

Building product partnering

Over the years, essential oils have shown potential to modify gut microbial populations and fermentation in monogastric and ruminant animals.

Among the essential oils screened, one of the most promising in monogastric animals has been from Origanum spp., which includes two primary active phenolic components, thymol and carvacrol.

Previous studies had shown the potential of thymol and carvacrol to improve Lactobacillus spp. and lactic acid production in mixed bacterial cultures.

However, the optimal ratio of the active components thymol and carvacrol as well as their effective feeding level remained to be elucidated. Laboratory and animal studies of these active molecules alone and in combination led to the conclusion that the efficacy on increasing Lactobacillus spp. was best shown with a 1:1 combination of thymol:carvacrol followed by thymol, and then by carvacrol alone.

The effects were linked in part to the stability of their molecular partnering. These authors showed that both of these ingredients when present alone had the capacity to undergo oxidative transformation to a different molecule.

This oxidation was spared only when the two ingredients are paired together due to the inherent anti-oxidation properties of these compounds.

Yeast and their cell wall extracts have been another area in which there has been a lot of attention focused over the years. Numerous publications have linked the feeding of yeast and their cell wall extracts to beneficial gut health.

Most of the work has centered on the mannoprotein contents of the cell wall which have the ability to agglutinate and interfere with the intestinal binding of potential harmful pathogens.

They have also been shown to improve intestinal integrity. However, recent progress on yeast cell extraction and isolation procedures have allowed experts to further expose yet another intriguing primary component, beta-glucans.

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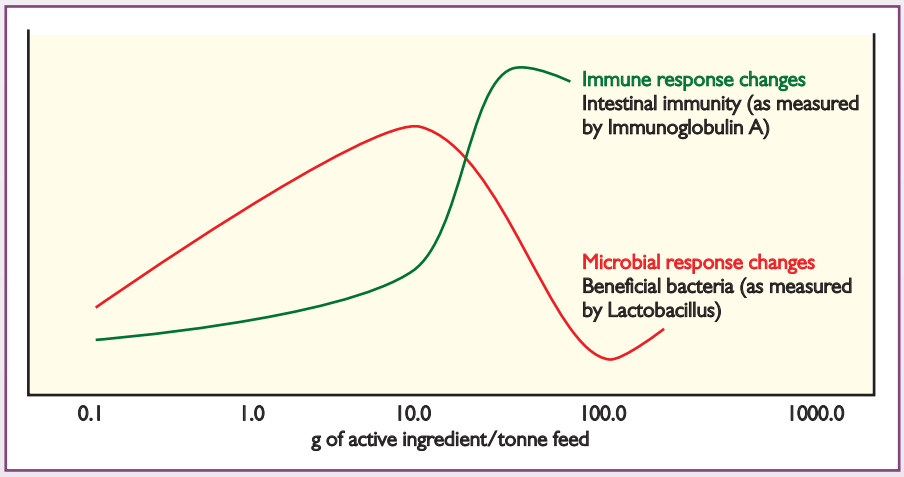
	Control diet without NE 100	Control diet with NE 100
Final weight at birth (kg) (1 day of age)	1.52	1.56
Final weight at weaning (kg) (28 days of age)	7.21[b]	7,66[a]
Final weight at 42 days post-weaning (kg) (70 days of age)	25.6[b]	26.8[a]
IgA in sow milk at 18 days lactation (mg/dl)	1.6[b]	2.4[a]
Lactobacillus log10 in pig faeces at 35 days post-weaning (63 days of age)	6.2[b]	7.8[a]

[ab]*Means with different letters are significantly different ($p \leq 0,05$).*
NE 100 : 1:1 equivalents of thymol and carvacrol, enhanced by patent-pending encapsulation process; yeast cell wall extract enriched for beta-glucan.

Table 1. Effects of supplementing a 1:1 combination of thymol and carvacrol with beta-glucan (NE 100) in a lactating sow diet followed by a post-weaning diet with an acidifier. Recordings were made on animal liveweight at days 1, 28 and 70 of age, IgA content of sow milk, and faecal Lactobacillus counts in post-weaning pigs.

Fig. 1. Shematic representation of dose related effects of increasing levels of thymol and carvacrol (red line) and beta-glucan (green line) on microbial and immune status, respectively, in the young animal (Kamel, 2006).



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This family of polysaccharides have received a lot of attention in sow and post-weaning pig systems, mainly due to their immune stimulating effects.

Recent feeding studies with beta-glucan sources has shown improved growth in young animals which is thought to be in part due to effects on stimulating the release of IgA to the mucosal surface of the intestine. IgA has long been touted as a watch-dog of the gut epithelium by virtually 'painting' the intestine surface with its molecules, which in turn inhibit attachment of potentially harmful pathogens.

The combination of thymol and carvacrol of Origanum with beta-glucan of yeast appears as a winning product partnering strategy with respect to the weaning period of the pig.

This solution would aim to boost Lactobacillus and IgA in order to provide the developing gut with two reactor systems to improve the surveillance system against potential pathogens such as E. coli and C. perfringens.

This indeed was the focus of an independent consortium of European university and industry experts investigating the potential product partnering benefits from thymol and carvacrol, the active components of Origanum spp., and beta-glucan, the active ingredient from Saccharomyces spp.

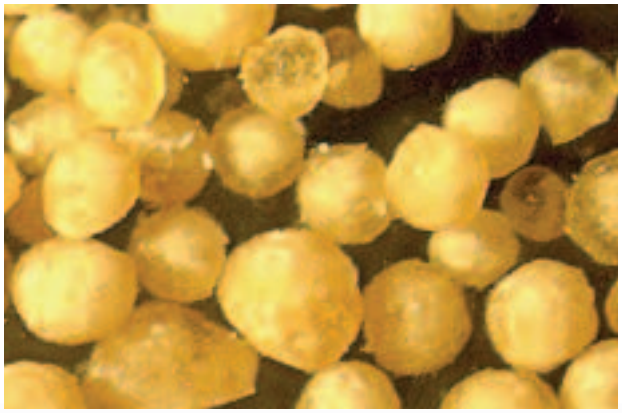

Photo at 40x magnification of 1:1 combination of thymol and carvacrol enhanced by a patent pending encapsulation process (Carotenoid Technologies SA, Tarragona, Spain) to protect against loss of active ingredients, palatability problems and potential release to the lower gut.

More is not always better

While it is of primary importance to accurately define the active components in any product partnering, defining the optimal feeding response level represents an equally critical step.

However, to date there are very few suppliers of alternative feed additives that have devoted time and expense to provide this information, either for their product alone or together with other potential product strategies.

With respect to the approach of Origanum and yeast active components, dose response work has defined the most effective inclusion levels at less than 50ppm for both the combination of thymol and carvacrol, and the beta-glucans (Fig. 1).

Increasing the dosage over this level only brings added expense without any significant measurable benefits. However, the low feeding levels of the active ingredients warrant a protection system that assures their fluidity and dispersibility in modern mixing systems and their stability under pelleting and expanding.

As thymol and carvacrol are aggressive components which like many other phenols have been shown to interact with yeasts, probiotics and prebiotics, only an effective method of protection and delivery based on microencapsulation of thymol and carvacrol allows producers to fully exploit their effectiveness with other products at optimal feeding levels.

Even though the concepts of microencapsulation and controlled release are relatively old, attention to these concepts with respect to plant extracts has been only recent.

A patent-pending process developed in Tarragona, Spain has shown the benefits for the accurate and controlled delivery of phytomolecules to the target site.

This method includes a two-step encapsulation process which is highlighted by two unique physical characteristics: first, the concentration of up to 57% of active material in a single particle, and second, the full encapsulation of this particle by a special layer of mono and di-glycerides which assures that all active components are retained below the surface.

Nowhere are these benefits more evident than with thymol and carvacrol. Without this protection system, studies under pelleting conditions have shown that up to 25% of thymol and carvacrol are lost either through volatilisation or oxidation.

With the addition of the protective layer, these substances are retained onto the core particle upon pelleting.

In addition, it optimises the mixability with other components such as beta-glucans with which they may potentially react.

An example of the particles with the enhanced protection system are shown in the photograph.

The added value of this protection system is the assurance that a consistent, stable dose of active material is delivered to the animal, and once inside the animal is released, and not before.

Benefits for the pig

The benefits of the partnering of a combination of thymol:carvacrol with beta-glucans (NE 100) at their optimal feeding levels have shown benefits in a number of studies conducted in sows and weaning pigs.

One such trial evaluating NE 100 alone in lactating sow diets and then together with an acidifier in post-weaning diets up to 70 days of age is shown in Table 1. The inclusion of this combination strategy significantly ($p<0,05$) improved liveweight gain both at weaning and at 70 days of age (42 days post-weaning).

The performance benefits from the feeding of NE 100 correlated with significant increases in IgA content in the lactating sow milk and faecal Lactobacillus counts from the post-weaning pigs which likely played a role in the absence of bouts of diarrhoea during the trial. Progressive livestock operations have discovered that putting more emphasis on intestinal health can help young animals combat enteric challenges.

One solution for young animal diets includes improving beneficial microbial and immune status in the young animal based on a 1:1 combination of thymol and carvacrol supplemented with beta-glucans.

Furthermore, these solutions can be positioned with other feed ingredients such as acidifiers as an enteric solution for the young animal and a cost effective feed strategy for the end user. ■